US005136377A

United States Patent [19]

Johnston et al.

[11] Patent Number: 5,136,377

[45] Date of Patent: Aug. 4, 1992

[54] ADAPTIVE NON-LINEAR QUANTIZER

[75] Inventors: James D. Johnston, Warren; Scott C. Knauer, Mountainside; Kim N. Matthews, Watchung; Arun N. Netravali, Westfield; Eric D. Petajan, Watchung; Robert J. Safranek, New Providence; Peter H. Westerink, Newark, all of N.J.

[73] Assignee: AT&T Bell Laboratories, Murray Hill, N.J.

[21] Appl. No.: 626,279

[22] Filed: Dec. 11, 1990

[51] Int. Cl.[5] H04N 7/12; H04N 7/01; H04N 7/04

[52] U.S. Cl. 358/136; 358/140; 358/141

[58] Field of Search 358/135, 136, 140, 141, 358/12

[56] References Cited

U.S. PATENT DOCUMENTS

4,051,530	9/1977	Kuroda et al.	358/136
4,202,011	5/1980	Koga	358/136
4,460,923	7/1984	Hirano et al.	358/136
4,562,468	12/1985	Koga	358/136
4,672,441	6/1987	Hoelzlwimmer et al.	358/136
4,689,672	8/1987	Furukawa et al.	358/136

OTHER PUBLICATIONS

Patent application Ser. No. 07/495525 filed Mar. 19, 1990 entitled "A High Definition Television Arrangement Employing Motion Compensated Prediction Error Signals", by S. C. Knauer et al.

Patent application Ser. No. 07/495523 filed Mar. 19, 1990 entitled "A High Definition Television Arrangement with Signal Selections Adapted to the Available Transmission Capacity", by S. C. Knauer et al.

Patent application Ser. No. 07/495507 filed Mar. 19, 1990 entitled "A High Definition Television Arrangement Including Noise Immunity Means", by S. C. Knauer et al.

Patent application Ser. No. 07/495559 filed Mar. 19, 1990 entitled "A Television Signal Arrangement Where Selected Signals are Encoded Digitally", by S. C. Knauer et al.

"Digital Pictures" by A. N. Netravali and B. G. Haskell, Plenum Press, 1988, p. 334 et seq.

"A Visual Model Weighted Cosine Transform for Image Compression and Quality Assessment", by Nill in IEEE Transactions on Communications, vol. COM-33, No. 6, Jun., 1985, pp. 551-557.

"Image quality measure based on a human visual system model", by Saghri et al., Optical Engineering, vol. 28, No. 7, Jul. 1989, pp. 813-818.

"Adaptive Quantization of Picture Signals using Spatial Masking", by Netravali et al., Proceedings of IEEE, vol. 65, Apr. 1977, pp. 536-548.

"Design of Statistically Based Buffer Control Policies for Compressed Digital Video", Zdepski et al., 1989 IEEE Conference, pp. 1343-1349.

Primary Examiner—John K. Peng

Attorney, Agent, or Firm—Henry T. Brendzel

[57] ABSTRACT

A quantizer, with quantization control that is sensitive to input signal characteristics and to output buffer fullness responds to an input signal that is divided into blocks and DCT transformed. The transformed signal is analyzed to develop a brightness correction and to evaluate the texture of the image and the change in texture in the image. Based on these, and in concert with the human visual perception model, perception threshold signals are created for each subband of the transformed signal. Concurrently, scale factors for each subband of the transformed signal are computed, and a measure of variability in the transformed input signal is calculated. A measure of the fullness of the buffer to which the quantizer sends its encoded results is obtained, and that measure is combined with the calculated signal variability to develop a correction signal. The correction signal modifies the perception threshold signals to develop threshold control signals that are applied to the quantizer. The scale factors are also applied to the quantizer, as well as a global target distortion measure.

31 Claims, 11 Drawing Sheets